(12) UK Patent Application (19) GB (11) 2 162 310 A

(43) Application published 29 Jan 1986

(21) Application No 8418817

(22) Date of filing 24 Jul 1984

(51) INT CL⁴
G01N 1/22

(52) Domestic classification
G1B CE
U1S 1987 G1B

(56) Documents cited
US 4344917 US 4336721

(58) Field of search
G1B

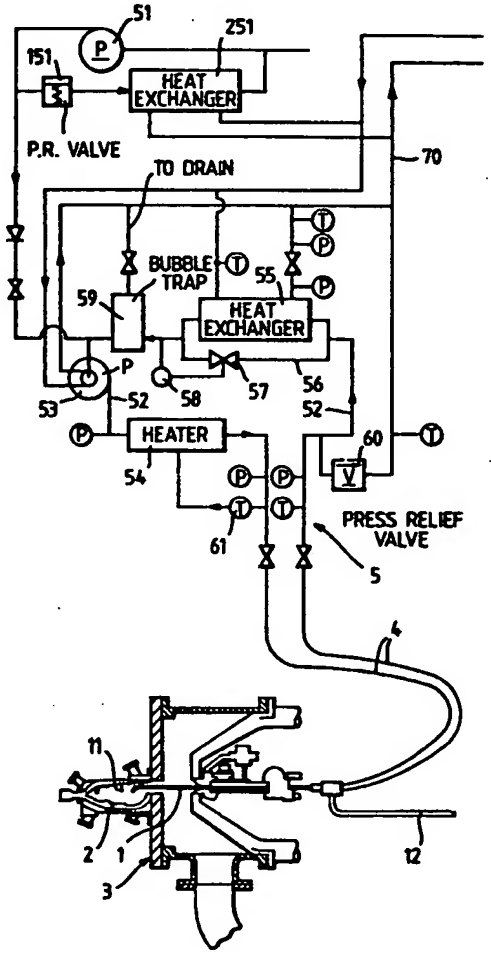
(71) Applicant
The Secretary of State for Defence (United Kingdom), Whitehall, London SW1A 2HB

(72) Inventor
John Brian Bullard

(74) Agent and/or Address for Service
W J Gunning,
Procurement Executive, Ministry of Defence, Patents 1A(4), Room 2014 20th Floor, Empress State Building, Lillie Road, London SW6 1TR

(54) Combustion gas sampler and conditioner

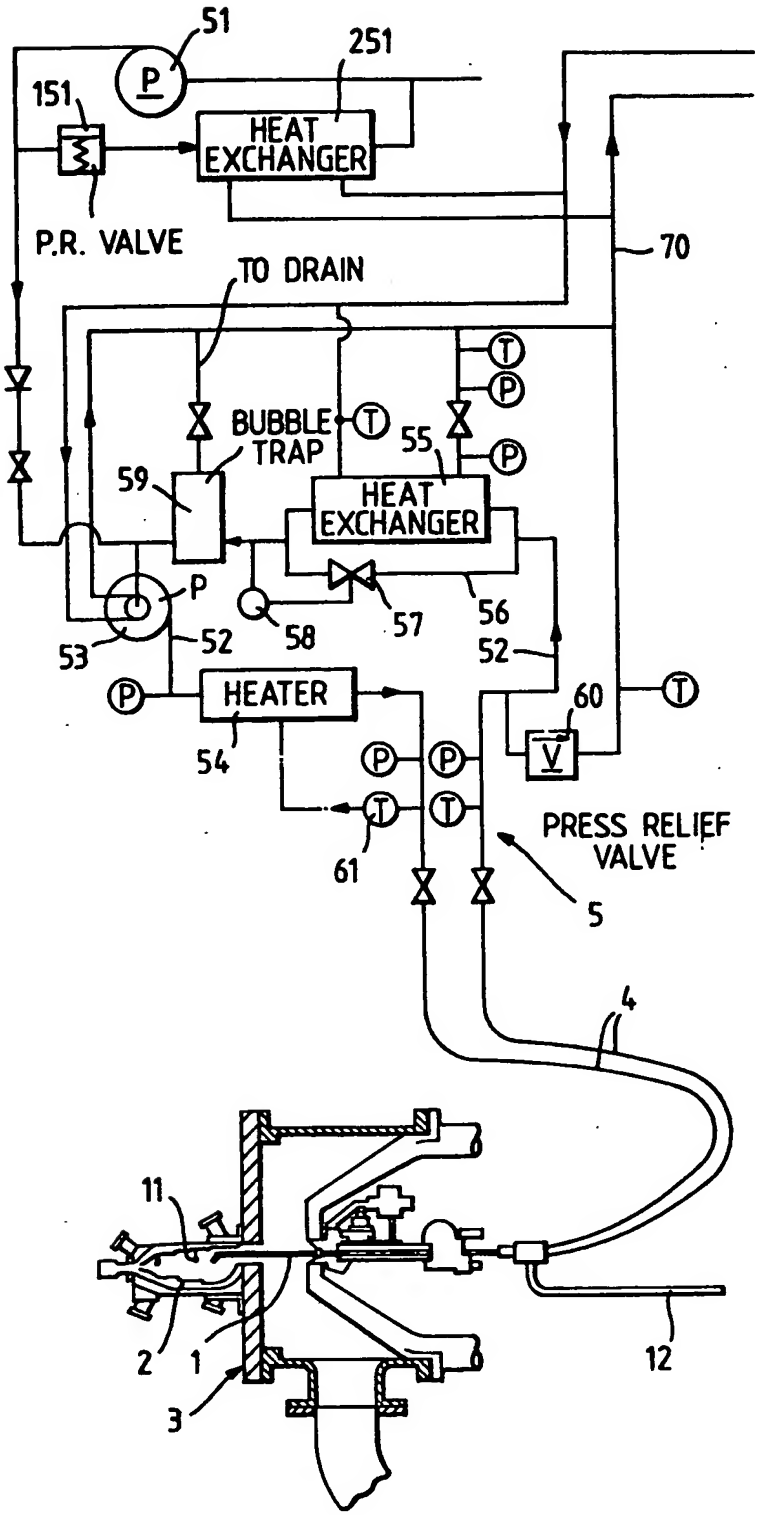
(57) A gas sampling probe (1) and transfer duct (12) for use with a gas turbine combustion chamber test apparatus (2) and an analysis unit (not shown) are surrounded by water or other fluid medium maintainable at the particular temperature by means of a heating system (54) and a cooling system (55), each separately capable of maintaining a constant sampling probe and transfer duct temperature at the maximum heat input to the fluid medium from the sampling probe. The gas sample is thereby quenched and maintained at a particular temperature at which neither further combustion of the sample nor deposition of the sample constituents can occur.



GB 2 162 310 A

The drawing(s) originally filed was/were informal and the print here reproduced is taken from a later filed formal copy.

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1982.


51
251
151
P
HEAT EXCHANGER
P.R. VALVE
TO DRAIN
70
T
P
BUBBLE TRAP
55
59
HEAT EXCHANGER
P
53
52
58
57
56
52
HEATER
54
60
V
PRESS RELIEF VALVE
61
5
4
11
2
1
3
12

SPECIFICATION

Combustion gas sampler and conditioner

The invention relates to gas sampling and conditioning probes, particularly, but not exclusively for use in the sampling and transfer of gaseous combustion products from a gas turbine combustion zone to an analysis zone.

The gas sampling probe for the primary combustion zone of a gas turbine combustion chamber must necessarily be of the smallest possible size to avoid upsetting the combustion from which the probe is to take samples. The probe must be able to withstand combustion temperatures exceeding 2000K and in combination with associated transfer duct must maintain the composition of the sample from the point of acquisition in the combustion zone to the analysis zone. To do this, the sample must be quenched to a temperature at which no further reactions can occur with a lower limit on that temperature so that none of the less volatile sample constituents can be deposited during transfer.

An object of the invention therefore is to provide a combustion gas sampler and conditioner in which the sampling probe and transfer duct are maintained at a temperature suitable to quench the gas sample and maintain it unchanged during the sampling and transfer procedure.

According to the present invention, there is provided a gas sampling probe and transfer duct for use in a gas turbine combustion chamber test apparatus in which the gas sample is quenched and maintained at a particular temperature at which neither further combustion of the sample nor deposition of the sample constituents can occur, the sampling probe and transfer duct being surrounded by a fluid medium maintainable at the particular temperature by means of separate heating and cooling systems, the heating and cooling systems each separately capable of maintaining a constant sampling probe and transfer duct temperature at the maximum heat input to the fluid medium from the sampling probe.

The particular temperature required may vary with the type of fuel in use, for example for kerosine fuels a temperature around 150°C and for diesel fuels a temperature around 190°C is required.

Preferably the fluid medium is water at greater than atmospheric pressure.

Preferably a minimum water pressure is maintained by a first pump to prevent boiling and cavitation within the sampling probe and circulation is maintained by a second pump of sufficient pressure to overcome the pressure losses in the water circuit.

To make the probe temperature insensitive to rig operating conditions or probe position, the circulating water leaving the sampling probe and transfer duct may be passed to the cooling system in which the heat exchanger is provided with a bypass, and flow is shared between these by a flow proportioning valve adjustable in response to the temperature of the circulating water at the entry to the circulating pump, to maintain the temperature of the water entering the pump at 20°C below the required temperature. This ensures that the heat pick up within the gas sampling probe is small compared to the heat flux in the heater and heat exchanger.

An embodiment of the invention will now be described with reference to the accompanying drawing, in which:

Figure 1 shows schematically the sampling probe transfer duct and associated temperature regulation system.

The sampling probe 1, the sample entry port 11 of which is situated in the combustion chamber 2 to be tested are both mounted within pressure vessel 3. The operation of the combustion chamber air, fuel supplies and exhaust systems are well known, do not form part of the embodiment of the invention and will not be further described. The sampling probe delivers the sample gas to an analysis unit (not shown) via a transfer duct 12.

The sampling probe 1 is supplied with pressurised hot water via flexible lines 4 from a supply system 5. The water is supplied to maintain a constant temperature of the sampled gas and to prevent overheating of the probe in the combustion zone.

The pressurised hot water supply system comprises a priming pump 51 to maintain a constant pressure of 20 bar in the hot water circuit 52. A circulating pump 53 capable of raising the water pressure a further 12.5 bar to overcome flow losses is provided to pump the hot water through the sampling probe and transfer duct water channels (not shown) which surround the pipe (not shown) carrying the gas sample. The hot water circuit also contains an electric heater 54, a heat exchanger 55 with bypass loop 56 and circuit temperature controlled valve 57 operated by temperature sensor 58. A bubble trap 59 and pressure relief valve 60 are also provided on the hot water circuit. The priming pump 51 supply pressure to the hot water circuit is limited by a second pressure relief valve 151 which discharges to the pump input via heat exchanger 251. The hot water circuit is supplied with demineralised wayer. A cooling water circuit 70 provides cooling for heat exchangers 55, 251 and circulating pump 53 and a drain for the bubble trap 59 and pressure relief valve 60. Pressure and temperature sensors for monitoring and warning purposes are provided at all locations in the hot and cold water circuit denoted with a P or a T respectively in a circle. The temperature sensor 61 controls the heater 54. Non return valves and flow control valves are denoted by standard symbols.

In use, to provide the shortest possible delay in establishing the required probe temperatures in relation to the fuel in use in the combustion chamber, the temperature sensor 58 holds heater 54 on continuously with the valve 57 in the bypass 56 full open. When the required temperature is attained, it is maintained by adjustment of the flow through the heat exchanger by means of the valve 57, and operation of the heater if the water temperature falls below the desired ranges as for instance when the combustion chamber is at idle condition and the heat flow to the probe is at its smallest.

CLAIMS

1. A gas sampling probe and transfer duct for use in a gas turbine combustion chamber test apparatus in which the gas sample is quenched and maintained at a particular temperature at which neither further combustion of the sample nor deposition of the sample constituents can occur, wherein the sampling probe and transfer duct are surrounded by a fluid medium maintainable at the particular temperature by means of separate heating and cooling systems, the heating and cooling systems each separately capable of maintaining a constant sampling probe and transfer duct temperature at the maximum heat input to the fluid medium from the sampling probe.

2. A gas sampling probe and transfer duct as claimed in claim 1 including a first pump to maintain the fluid medium at a pressure which is sufficiently high enough to prevent boiling and cavitation within the sampling probe.

3. A gas sampling probe and transfer duct as claimed in claim 2 including a second pump for circulating the fluid medium at a required rate.

4. A gas sampling probe and transfer duct as claimed in claim 3, wherein the cooling system includes a heat exchanger provided with a bypass, and a flow proportioning valve for dividing flow into the heat exchanger and the bypass in response to the temperature of the fluid entering the second pump to maintain the fluid at a temperature sufficiently low to ensure that heat pick-up within the gas sampling probe is small compared to the heat flux in the heater and heat exchanger.

5. A gas sampling probe and transfer duct as claimed in any previous claim wherein the fluid medium is water.

6. A gas sampling probe and transfer duct as hereinbefore described with reference to the drawings.

Printed in the United Kingdom for
Her Majesty's Stationery Office, Dd 8818935, 1988, 4235.
Published at The Patent Office, 25 Southampton Buildings,
London, WC2A 1AY, from which copies may be obtained.